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ABSTRACT

The details and process of evaluating computerized instructional materials are presented for the major classes of such materials, i.e., courseware--the set of computer programs with which the student interacts directly to learn--and instructional software--the instructional facilities, services, or general operations which include management and testing. Formative and summative evaluation, both used to evaluate conventional materials, are considered appropriate, but two different points of focus are indicated for use with computerized materials: the interaction focus and the subject matter focus. The interaction focus concentrates both on the mechanical aspects of interaction, e.g., the function of keyboards, and such logical and communication aspects of interaction as the dialogue with the student and the degree of individualization. The questions to be asked and the data to be gathered are provided for evaluating materials in each class, but it is pointed out that first hand experiences are mandatory to get a true measure of the characteristics and usefulness of any instructional computing program. This resource for preservice and inservice teacher training includes a study activity, two references, and a courseware evaluation worksheet. (CMV)

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Number 5e

The Illinois Series on Educational Application of Computers

EVALUATING MATERIALS FOR TEACHING WITH A COMPUTER

J.Richard Dennis

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To the reader,

This is one of a series of documents prepared as resources for the inservice and preservice training of teachers. The general theme of all items in this series is "teaching with or about computers". The booklets are the collective work of a variety of staff and students (both present and former) of the College of Education, University of Illinois at Urbana-Champaign. The project generously was supported between 1977 and 1979 by a grant from the EXXON Education Foundation. All responsibility for the content of these documents rests with the authors and does not reflect necessarily the views of the EXXON Foundation. It was my extreme pleasure to direct this effort throughout.

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EVALUATING MATERIALS FOR TEACHING WITH A COMPUTER

Teachers frequently must make selections among learning materials for their classes. For most teachers, these choices involve printed supplementary materials for use in a course. Less frequently, teachers participate in choosing basic texts for a particular course. Considered in making such decisions are the topics included, the scope and sequencing of the topics, the instructional approaches or models used, the type and difficulty of exercises involved, appearance, and relatively the ease in which a product can be used by all concerned.

During the 1960's, as the computer came to be used more and more for instruction, there arose a demand for a whole new genre of instructional materials we loosely have come to call "computerized lessons". Early on, these lessons mostly were the creations of the involved teachers or their students. Seldom was a conscious evaluation required because attention had been paid at each step of the creation process. As more and more such "lessons" were created, teachers might occasionally have faced a decision between two activities involving the same topics arising from a trade with another computer using teacher. For the most part, however, each lesson derived this way was an "only show in town" commodity and hence, required little in the way of formal evaluation.

By the late 1960's, a small number of sources external to schools began to offer computerized lessons for one or another classroom use. One of these sources was user's groups associated with major hardware suppliers. Publications were supported to include computer lessons written by company personnel or by teachers or students sending contributions. Also, during this period of time a few funded projects (e.g., the Huntington Project) were initiated to produce computer courseware--computer programs intended directly to deliver some type of instruction. However, quantities were low. In most cases a teacher's decision came down to using or not using a particular sample.

By this writing in the late 1970's, we are seeing the initiation and growth of companies engaged in the production and publication of computer lessons. As the quantities and variety produced increase, we eventually shall reach a point at which there are several choices available for many individual teaching situations. Then also for computer lessons, teachers will be faced not only with a "to use or not to use" decision, but also with a choice among several similar but different alternatives. Teachers will need to become familiar with appropriate bases on which to make these decisions.

Computerized instructional materials require evaluation, perhaps even more than text materials, since computer lessons frequently must function relatively independent of human intervention. In using a text, or even a set of exercises in a text, teachers frequently will alter, augment, or eliminate pieces of the material. Sometimes this is done on a rather spur-of-the-moment basis with only intuitive justification for the change. Such manipulation is not nearly so easy (if possible at all) with computerized materials.

To evaluate computer lessons, one must consider all aspects mentioned earlier for printed material. However, we have argued, that computerized lessons are more than textual in the conventional sense in that computer lessons (properly constructed) involve the attributes of interaction and individualization potentially in a way, and to a degree, never before found in other than the instruction of a talented human. To make intelligent selections among similar computer lessons and, more thoughtfully, to make decisions on whether or not to use a one-of-a-kind item, teachers who are using computers to aid them in teaching will need to acquire new evaluation skills and standards relative to the attributes of individualization and interaction.

This paper is devoted to the details and a process of evaluating computerized instructional materials. There are two major classes of such materials one of which we mentioned above. Courseware is the set of computer programs with which the student directly interacts to learn. Courseware directly is visible to the student and roughly can be thought of as a computerized lesson, part of a lesson, or curriculum.

The other large class of computer programs used for instruction is that which we call instructional software. These programs provide instructional facilities, services, or general operations such as management, testing, etc. However, they are general programs in that they do not work alone to instruct. A software program must be accompanied by the specific content, questions, etc., it will use to fashion specific instructional episodes. Instructional software consists of the utility programs of computer-based instruction. Software is to interactive instruction what the cassett player is to recorded audio instruction. To operate as it does, the cassette player needs a tape of the specific recordings to execute in its mode.

There are two types of evaluation conducted for conventional instructional materials and appropriate also to the evaluation of computer instructional materials:

1. Formative Evaluation: Evaluation conducted in the process of materials development. Directed at assessing and improving ingredients and procedures of the materials.

2. Summative Evaluation: Evaluation conducted after development is completed, to determine learning outcomes derived from materials.

For instructional courseware and software both of these types of evaluation need to include two different points of focus:

1. Interaction Focus: The overall nature and quality of the interaction available to the student.

2. Subject Matter Focus: Analysis of the content, terminology, topic organization, teaching strategies, choice of examples, etc.

The interaction focus of the evaluation must concentrate both on the mechanical aspects of interaction as exhibited by the function of keyboards, etc., and on the logical and communication aspects of interaction as exhibited by the dialogue with the student, the degree of individualization, etc.

To make decisions about the use of printed instructional materials, a teacher at least must read those materials. Much better evaluation can be presented if one actually can witness the use of the materials, at least on a limited scale. Often this is impossible.

Computer courseware and software are more difficult to evaluate because it is difficult to describe interaction in a way that one can visualize the experiences. To date there has been only limited success at accurately describing instructional programs in a manner that facilitates evaluation by a teacher. This situation almost demands that materials actually be experienced, at least by the teacher playing the role of student, if not by the teacher witnessing their use by students.

EVALUATION OF COMPUTER COURSEWARE

We shall separate consideration of instructional courseware and instructional software in this discussion of evaluation. In our discussion here of the evaluation of courseware, we mainly shall be considering courseware prepared commercially and purchased by schools. From other less formal sources, the teacher will need to do more preparatory work before a good evaluation can be conducted.

Preparing for Evaluation

There are several types of data and information helpful in the preparation and organization of a courseware evaluation. In the best of all worlds, the publisher or author would make these easily accessible to the teacher. Of course, such will not be the case from all courseware sources, but this discussion will provide a basis for deciding what information it is reasonable to request.

For courseware reviews, the following are useful. Generally, this list applies whether the courseware constitutes a single lesson or a set of several lessons:

1. Material Information
    1. Description of material and objective
    2. Curricular plan within and around lesson
    3. Flowchart of individualizing paths with courseware
    4. Copies of, or references to ancillary material
    5. Program listings and related documentation
2. Student Information
    1. Audience descriptions
    2. Expected entering behaviors
    3. Means of "shadowing" typical students through material
    4. Expected terminal behaviors

The list of desired information about the courseware itself may seem overly elaborate to a person who has not attempted evaluations of computerized teaching materials. One must remember that when evaluating text or printed materials, it is possible

rapidly to scan large protions of the material to see what is contained. Entire lists of exercises can be seen at once, as can attributes like graphics and layout, etc. Vocabulary requirements can be sampled this same way.

Computer courseware is not so readily transparent or observable. For one thing, what is viewed by the student usually never is visible nearly as a whole. If the lesson truely is interactive and individualized, what would be experienced by different students also significantly should differ.

In a description of computer courseware, one would expect to see objectives, descriptions of instructional philosophy or strategies, and descriptions of features of the material. Somewhat more detail is required about the curricular environment within which the computer material is to function. This is necessary so that the teacher can determine the extent to which the computer material is independent. If not intended to be a stand alone experience, the teacher needs information on those experiences assumed both before and after the computer material, and the expected sources of such experience.

The extent to which instruction is individualized is very difficult to exhibit in second hand descriptions. Of more value in this respect are flowcharts of the instructional logic. Also valuable in judging individualization dimensions is a means of "shadowing" one or more typical students through the material. These can take the form of dialogues produced by various student types. At the very least, it is helpful to have such a dialogue for a very successful student and one for a not so successful student. If these two dialogues differ only slightly (or not at all) then the lessons are not very individualized.

Sample student dialogues and a lesson flowchart also are useful to help determine the nature and degree of the interaction of the material. Particularly important here is the extent to which the question episodes accomodate synonymous correct answers, conceptually correct but literally incorrect answers, predictable incorrect answers, and all other answers.

Program listings may not be required for an initial evaluation if the other information is available in the forms discussed above. Commercial courseware publishers may not make program listings available under any circumstances because of desires to preserve copyrights on material. In these circumstances, the company makes available an executable version of the material, but not printed representations of the programs per se. The value of a program listing is as an approximation for either a lesson flowchart, or for individual student dialogues. The program listing is much more difficult to use for such purposes since any decision structure built into the lesson logic must be deciphered by the evaluator.

Program listings have a second value in cases where teachers expect to purchase the courseware but wish to make alterations to it. In such cases, one would want to look at the quality and organization of the program, as well as, at the completeness of explanatory documentation in the program.

Conducting an Evaluation

It almost is impossible for teachers accurately to assess the value of text materials without seeing them in action. Often, teachers select and purchase textbooks, sometimes even after lengthy examination, only to decide a year later that it is not as they had expected in the classroom. Since there is little else one can do to "test" classroom materials, text publishers cooperate in classroom trials of their products.

The need actively to examine computerized learning materials is even more acute due to the interaction and individualization which hopefully will be present. The position taken here is that these attributes cannot fully be assessed other than through executions of the materials by a teacher. "Shadowing" dialogs of a couple of student types can help in this process but will not be adequate for a thorough understanding of the decision structure of the material.

There are four types of executions of courseware that can be valuable in conducting an evaluation:

1. Orienting executions
2. Focusing executions
3. Rating executions
4. Student executions

The first three of these are conducted by a teacher. If conducted by an experienced teacher, the need for the fourth type of execution greatly is decreased.

Orienting executions usually are few in number and are intended to help gain an overview of the courseware and what it does. At this stage, the teacher merely makes notes about parts of the courseware deserving more attention later. Also notes are the initial reactions or first impressions of the material. No attempt is made at this stage to do other than traverse the path of a reasonably successful student.

Focusing executions are an attempt to flesh out perceptions of the courseware and what it does. At this stage, the teacher/evaluator begins entertaining and testing hypotheses about the performance of the courseware (What would happen if . . .?) Important to confirm are the general attributes of the courseware (instructional strategy, student facilities available, communication attributes, etc.) This stage will require several executions in order to detail your perceptions of the material.

At the end of the focusing executions one should compare their "picture" of the courseware and what it will do for a student to those of the author/publisher. Discrepencies undoubtedly will be revealed. These discrepencies initiate the rating stage of courseware specific points. Additional executions of a leson may be required to resolve discrepencies between the reviewer's view and the author's view.

To complete a review, it usually is desirable to observe students interacting with computer lessons. Usually, a small number of student trials will solidify an evaluation. Of course, the students chosen for this are as nearly representative of the target audience as possible.

Recording an Evaluation

As may have been guessed by reading the above descriptions of the process of evaluating computer courseware, organization and careful records are needed in assessing such materials. This organization can be provided by some sort of record keeping instrument. A sample of such an instrument is included in Appendix A. Not all items of this recording instrument will be used for each item of courseware. Rather, an attempt has been made to provide an instrument helpful for most courseware evaluation needs.

EVALUATION OF INSTRUCTIONAL SOFTWARE

Instructional software consists of an array of utility programs intended to facilitate computerized instructional activities. Unlike courseware, for which the topic, content, and instructional role specifically is defined, any one software program embodies a class of similar instructional tasks but, at least initially, may not specifically present any one instance of the class.

The variety of software appropriate to instruction ranges widely from facilities to expedite the creation and presentation of tutorial lessons to facilities to aid in various inventory operations. Systems to control and to aid implementation of computer managed instruction are an example of instructional software as are programs to facilitate computerized testing or item banking.

When seeking instructional software, the most important first question to ask is:

What instructional tasks do we wish to do with a computer?

Programs suitable for aiding practice might not be useful for problem solving activities. On the other hand, a program designed to keep student records, if properly structured, very likely would be useful to inventory laboratory equipment. Also, facilities of this type can vary widely in their usefulness depending on the experience or expertise of the potential users. A problem solving language appropriate for use by elementary or intermediate grade children might frustrate older high school students. Of course, not all software works on every computer. So our list of initial questions expands to include:

1. What instructional tasks are to be performed by a computer?

2. What is the context in which these tasks take place?

3. What is the expertise of the intended users?

4. How well does the package fit existing equipment?

Once you have determined what a particular software package should do and have identified one or more sources of such a program, you are then in a position to make an evaluation. For software, some of the most important questions asked are:

1. How well does the package match the task defined?

2. How easy is the package to modify?

3. How much does the package cost?

4. How well is the package documented?

5. Where can the package be seen in operation?

The balance among the answers to these questions is very important to consider. A software package apparently providing the services desired, but either poorly documented or not available in a form that is modifiable (e.g., no source program available) will be both very difficult to learn to use and almost impossible to alter in the future. If being purchased from a vendor who offers adaptation of the program at little cost and readily available assistance with implementation and personnel training, then the quality of the documentation perhaps can be overlooked.

The match of the software to the computer may be a matter of programming changes or it may be a matter of new equipment demands. Computer testing systems, to operate efficiently, may require faster input or output devices than currently available on your school's computer. Or, if the software was written for a slightly different computer, how is the adaptation to your system going to be accomplished and by whom?

There are several ways to weigh decisions on the ease of use of a software package. A more explicit question to ask is about ease of use by whom? A program easy to use by somewhat knowledgable and experienced instructional computer users may be a burden or totally obscure to beginners. So, we need to ask about the goals and future of instructional computing in your school. Do you wish to attract more teachers to use the computer with their instruction and thus to spread the cost across a larger population? Do you wish to make, say, computer experiences available to a wider range of student abilities than the most talented? Answers to such questions may have an important bearing on choices of software. Generally, the less knowledgable or experienced the potential users of software, the more "user oriented" that software must be in terms of foolproof operation, user prompting at decision points, etc.

Claims for software can vary as widely as claims for any other educational resource or commercial product. The only way to test the operation of instructional software is to see it in operation, preferably in a context as nearly like the intended context as possible.

SUMMARY

Two types of computer programs used in instruction are referred to as software and courseware. Courseware are programs that present aspects of instruction on identifiable topics. Software are programs offering generalized classes of instructional service. Both types of instructional programs can come in a wide variety of qualities. Both must carefully be evaluated to determine the match between the intended use and the nature of the programs. The questions to be asked and the data to be gathered in evaluating courseware or software for potential use vary. The one consistant for both is that first hand experiences are mandatory to get a true measure of the characteristics and usefulness of any instructional computing programs.

STUDY ACTIVITY

Select a computer lesson (or support system) for a topic in your field. Conduct an evaluation and prepare a report building a case for or against adoption of the lesson (or system).

BIBLIOGRAPHY

Francis, L., Goldstein, M., and Sweeney, E., "Lesson Review" PLATO User's Memo Number 3, CERL, University of Illinois, 1975.

Hansen, R.W., and Shostak, A.D., "How to Evaluate and Select Software", ERIC ED 087460.

APPENDIX A

COURSEWARE EVALUATION
WORKSHEET

I. Reviewer Data

Your Name _____

Date _____

Your Area of Content Expertise _____

II. Orienting Execution:

Execute the material in a relatively straight forward manner. At this stage, avoid trying to make errors. Avoid being distracted by typographical errors and other details.

A. List (as you go along) places where you wish to pay special attention later.

B. List the initial thoughts or reactions you have to (parts of) the material.

C. Summarize your overall initial impression of the material.

III. Focusing Execution(s)

More detailed examination of the materials including some hypothesizing by the reviewer (What would happen if . . .?)

A. Descriptors

General Features (check all applicable items)

1. Material Strategy:

___ Dialogue ___ Drill and Practice ___ CMI

___ Gaming ___ Problem Solving

___ Tutorial ___ Simulation

Other _____

2. Program Style:

___ Linear ___ Strongly Individualized

___ Simply Branched

Other _____

3. Teaching Strategy: (if material is intended for initial instruction)

___ Student controlled discovery

___ Guided discovery (Socratic)

___ Exposition/questioning

___ Discovery through a game

___ Other _____

Student Facilitation (check all applicable items)

1. ___ Index (Table of Contents) available

___ Flow chart available (to student)

___ Objectives available

2. ___ Review available at any time/sometimes/not at all

___ Help available at any time/sometimes/not at all

3. On-Line Proctoring:

___ Direct Communication

___ Indirect Communication (i.e., notes)

___ Observation only

___ None

4. Student Performance Reocrds kept:

___ For Teacher ___ For Student ___ For Lesson

___ For Evaluator ___ None kept

5. Richness:

___ Animation ___ Interactive Graphics

___ Voice Output ___ Black and White Slides

___ Touch Input ___ Slides Superimposed on Display

___ Light Pen ___ Off-line material

___ Color Slides ___ Paper Copy Available for Students

6. Use with Other Educational Media:

___ Preceding instruction expected ___ Film

___ Follow-up discussion expected ___ In Class

___ Outside reading expected ___ Lab

Can or should be used with TV ___

7. Means of Affective Maintenance (interest, involvement, or attention)

___ Personalized material ___ Competition ___ Tests

___ Surprise or uncertainty ___ Student contract ___ Logic

___ Importance ___ Aura of personal responsibility for outcomes.

Other _____

8. Tone of communication

___ Condescending ___ Neutral

___ Sarcastic ___ Friendly

9. Complexity of information exchange (check appropriate designation):

Student Input

simple 1___ 2___ 3___ 4___ complex and varied

Judging and Diagnosis

simple 1___ 2___ 3___ 4___ complex and varied

Feedback

simple 1___ 2___ 3___ 4___ complex and varied

Branching

simple 1___ 2___ 3___ 4___ complex and varied

Review

never 1___ 2___ 3___ 4___ often and varied

10. Control of Path Through Material:

___ Student ___ Author ___ Both

11. Can Parameters be Changed by:

___ Student ___ Author ___ Both

12. Duration (estimate _____

B. Detailed observations

1. List what you observe to be the objectives of this material.

2. What do you observe that the author has assumed the students to know or to be able to do?

3. Briefly list (or note) the information presented by the material (content, concepts, principles, facts).

4. Make a flow diagram of the idea flow as you perceive it. (Use separate sheet if necessary).

5. Does sequencing of topics (as you observe it) make sense? If not, explain.

6. List skills needed by the student to interact with the material (typing, spelling, computational, reading, rules of a game).

7. Describe individualizing features for a successful student.

8. Describe individualizing features for an unsuccessful student.

9. List instances where branching in the flow has been used effectively.

10. Describe the practice provided by the material. How much is provided? Is is massed or distributed?

11. List instances in which you feel the student is not provided adequate information to complete the given task and/or to make a response.

12. List any instances in which student responding may be influenced by extraneous factors.

13. List instances in which the content and/or questioning appear unnecessary or insufficient to successful attainment of the objectives.

14. Describe the provision made for multiple incorrect responses?

15. Describe methods used to insure learning in situations where initial responses are correct.

16. Describe methods used to insure learning in situations where initial responses are incorrect.

17. Describe methods used in cases where responses conceptually are c correct but literally incorrect.

18. Describe the lesson's methods of evaluating student achievement of objectives.

IV. Rating Execution(s)

Characteristics of the material which require a rating or judgment by the reviewer may require additional executions or other examinations.

A. Direct judgments

	Poor 1	2	3	4	Good 5	Not Applicable
1. Input/Output:						
Legibility						
Audibility						
Ease of Student Input						
Speed of Response						
Other						
2. Clarity of:						
Vocabulary						
Text						
Definition of topics						
Displays						
Directions and Advice						
Examples						
Lesson development						
Other						
3. Optimal Use of Medium With respect to:						
Sight						
Touch						
Sound						
Other						
4. Ease of Use:						
Easy access to proper section(s)						
Dead-end paths						
Other						
5. Suitable Length						
6. Goals:						
Appropriate to students						
Match teaching of lesson						

B. Indirect Judgments

	Poor 1	2	3	4	Good 5		Not Applicable
1. Maintenance of:							
Relevance							
Involvement							
Attention							
Motivation							
2. Production of Good Affect: Friendly and personalized							
Plays fair							
Avoids frustration							
Humorous							
Other							
3. Opportunity for Student Creativity							
4. Presentation: Originality							
Variety							

C. List instances in which skills or knowledge specified in objectives are not consistent with those being emphasized in the material.

D. Note any points of discrepancy between the objectives (as you see them) and the content presented. Also include any suggested changes in content.

E. Compare the flow diagram you made with the one provided by the author. Resolve (or verify) any discrepancies and list those you are unable to resolve.

F. List any points on which your observations of student entering abilities are in conflict with the author's described student populations or list of prerequisite behaviors.

G. Note any points of conflict between the strategy (drill and practice, tutorial, etc.) and your perceptions of the objectives.

H. Are the teaching strategies observed in the material in agreement with the objectives and/or intended students? Explain.

I. List instances in which you feel explanations are unclear, and the nature of the lack of clarity. Include instances in which terms, jargon, conventions are used but not explained.

J. List instances in which interaction (type or amount) is not consistent with the objectives, content, intended audience.

V. Observations of Executions By Students

In some cases, evaluation of material may require data derived from observing an actual student using that material.

A. List instances in which there were delays in responding by the student. Include any information you could derive on the reason for each delay.

B. List instances in which there were definite signs of frustration by the student. Include information you could derive on reasons for each frustration.

C. List instances which the student exhibited high levels of motivation or interest. Include information you could derive on reasons for this.

D. List instances in which the student's attention to task apparently decreased. Include information derived on reasons for such drops in attention.

E. List those instances in which the author attempted to direct the student's attention to important aspects of the material. Include your observations on the success of such efforts.